Linking Use Cases and Associated Requirements: On the Impact of Linking Variants on Reading Behavior

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Abstract: A wide variety of use case templates supports different linking variants. The main purpose of all linking options is to highlight the interrelationships between a use case and its associated requirements. Regardless of the linking, a reader needs to consider all materials together in order to achieve a high understanding of the overall content. Due to the efforts of creating and maintaining links, we investigated their impact on the reading behavior in terms of visual effort and intended way of interrelating both artifacts in an eye tracking study. Our findings show that all investigated linking variants cause comparable visual effort and share the most frequent reading pattern. In all cases, the use case and the requirements are read separated and successively. Nevertheless, we found significant differences in the reading behaviors between the linking variants. Only the most detailed linking variant significantly increases the number of attention switches between both artifacts which represents the required reading behavior of interrelating both artifacts. This summary refers to the paper "Interrelating Use Cases and Associated Requirements by Links – An Eye Tracking Study on the Impact of Different Linking Variants on the Reading Behavior" [KRS18] which was published as original research article in the proceedings of the 22*nd International Conference on Evaluation and Assessment in Software Engineering*.

Keywords: Linking; reading behavior; eye tracking; visual effort; attention switch

1 Introduction

Coleman [Co98] included a field for non-functional requirements in his proposed use case template. Based on this idea, further templates were invented to add any associated requirement to a use case. These templates provide different options to link to associated requirements. Based on literature, we identified three widely used linking options. Besides *no linking*, templates include either an *additional field* or *integrated links* in typical fields to list associated requirements. Links are mainly realized by labels that consist of identification numbers. These labels are one source for risky, dispersed changes of a use case. Due to the effort to create and maintain links, we investigated the following research question:

Research question:
Does the linking variant of a use case and its associated requirements influence the reading behavior in terms of visual effort and intended way of interrelating both artifacts?

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2 Study and Results

We conducted an eye tracking study in a between-subjects experiment with 3 groups each with 5 subjects to compare the three linking variants. Each linking variant was applied to the same use case and requirements. Based on the collected eye tracking data, we investigated the impact of the three linking variants on the reading behavior.

Visual Effort: We analyzed the visual effort by using three different metrics (*fixation count*, *fixation duration*, and *dwell time*). Based on all three metrics, there is no significant difference in the visual effort between the three linking variants. Therefore, the three linking variants cause comparable visual effort. Thus, adding links to a use case does not impact the visual effort of a reader.

Intended Way of Interrelating Both Artifacts: We analyzed the reading behavior of our subjects by applying sequential pattern mining on their scan-paths to identify *frequent reading patterns* and comparing their *attention switching frequencies*. According to our results, the main reading pattern of all three linking variants is the successive reading of the single artifacts (use case and requirements) one after the other. Only in case of *integrated links*, the joint consideration of the related materials, so-called intended way of interrelating both artifacts, occurs as a frequent reading pattern. This finding coincides with the analysis results of the attention switching frequencies. *Integrated links* significantly increase the number of attention switches between both artifacts. **The *integrated links* variant is the linking option that most increases a reader's efforts to interrelate both artifacts.**

3 Conclusion

The particular linking variant of a use case with its associated requirements has an impact on the reading behavior. Adding links to a use case does not increase the visual effort for a reader. However, the position of a link has an impact on how intensive a reader interrelates the connected artifacts. Our work indicates that all three linking variants do not impede the reading of the two artifacts for themselves. Nevertheless, the specific reading behavior of interrelating both artifacts is only supported by the detailed integration of links in a use case description. Based on our findings, we recommend preferring on the most detailed linking variant *integrated links*.

References

[Co98] Coleman, D.: A Use Case Template: Draft for Discussion. In: Use Case Template Guidelines. 1998.

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